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ABSTRACT

Fourth- and fifth-grade students were given a series of five lessons for individual study over the summer vacation. The lessons, which sought to help maintain basic skills, were to be completed and mailed back to the schools. Over half of the participating students completed all the lessons. Results of the STEP Computation Test administered in September showed that these students maintained their levels of basic skills while ones that did not complete the lessons, as well as students in a control group, had lower scores. As a result of the summer lessons, some teachers were able to reduce substantially the amount of time devoted to review at the beginning of the following school year. (Author/LS)

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USING A POTENTIAL METHOD OF MAINTAINING THE BASIC SKILLS OF ARITHMETIC THROUGH THE SUMMER MONTHS TO REDUCE THE REVIEW TIME IN THE FALL

by

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ABSTRACT

The purpose of this practicum was to attempt to maintain the basic arithmetic skills of a group of fourth and fifth grade students during the summer vacation in order that the amount of review time in the fall could be reduced. Lessons were developed for the students to use during their vacation. At the end of the summer, the results indicated the skills of the students who completed the lessons remained at a higher level than the control group. Subsequently, the teachers of these students were able to reduce the amount of review time necessary for the students to successfully approach the new material for their grade level.

INTRODUCTION

Teachers at all levels and in all subject areas frequently complain that their students don't remember important facts, skills, or information which are necessary for the students to continue with their course of study. This complaint is especially prevalent in the fall of the year and is frequently directed toward the basic skills of mathematics. With this complaint in mind, teachers then proceed to spend as much as nine to twelve weeks in the fall of the year in review of "basic skills."

This complaint is not entirely unfounded. Evidence was presented by Kurtz (1973) that there was a significant loss of ability of beginning fifth grade students to work division problems when compared to their ability to work similar problems at the end of fourth grade. He also reported that students in the upper quartile registered considerably more loss than the students in the lowest quartile, suggesting that this was probably due to the fact that they have more to forget.

On the other hand, Mousley (1973) presented data which indicated there was no loss in the reading ability

of third graders, and in fact reported a slight gain between May and September. He proposed the possibility that the children's normal maturation and their tendency to practice reading for pleasure might account for the maintenance of their reading skills, while they do not practice other basic skills such as arithmetic.

The loss then is probably not as bad as teachers tend to believe, but probably does exist to some extent. This situation logically leads to two basic questions for which answers should be sought. They are:

1. Can some simple scheme be developed by which the basic arithmetic skills can be maintained over the summer months?

2. If such a scheme is developed and proves successful, how can the results be used to reduce the amount of time spent by teachers on "basic skills"?

A search of the literature revealed many studies similar to the one done by Kurtz in which the learning loss was established. However, few solutions were attempted, with most utilizing a regular summer school approach; and nearly all were directed toward the underachiever. For instance, Sinatra (1973) conducted a summer reading program utilizing a point reinforcer system. In this system, a child earns points contingent

upon task completion which can be traded for tangible rewards. His major goal however, was instruction rather than maintenance and was designed for underachievers and low achievers.

Acknowledging the fact that the best solution would be to extend the school year, it must be recognized that it is financially impossible to do this at the present time. Hence, the reason for the following alternative proposal which utilizes self study lessons to maintain the skills and uses the results of a statistical analysis to persuade teachers to reduce the review time.

THE PROPOSED SOLUTION - PART I

Population Description

In order to keep the investigation of the proposed solution manageable, it was necessary to limit this study to only include students who completed the fourth or fifth grades in June, 1973. These students currently attend one of four elementary schools in three districts. The purpose of using students from these school districts was to ensure a range of backgrounds, ability, and varied teaching strategies.

One of the districts chosen is primarily rural, one primarily middle class suburban and urban, and one primarily upper middle class suburban. In addition the teaching strategies used in the four schools range from self contained classrooms to open - nongraded teams.

After establishing the population limits for manageability, the problem of cooperation was considered. If the school personnel are not involved and/or do not approve of the proposed solution, it is useless to attempt it. Therefore, school personnel input and approval were sought at each step of the proposed

solution.

General Plan

The general scheme that was decided upon to attempt to maintain the basic arithmetic skills over the summer consisted of a series of lessons (five) which were sent home with the students at the end of the year. The series of lessons was to be completed at the rate of approximately one every other week during the summer months. Along with the lessons, directions and answer keys were sent for the parents' use. When the child completed each lesson, it was either self corrected, or the parent corrected it for him. The attempted or completed lesson was then returned in a stamped pre-addressed envelope provided for its return.

The reasons for setting up a return scheme were for record keeping pertaining to the number of lessons completed by each student and to act as a link between the home and the school. It was felt that the link between home and school needed to be maintained even though a study conducted by Sabers (1972) indicated that post cards and letters of encouragement did not reduce the attrition in correspondence study courses. However, his

study did indicate a positive difference based on student time in the program, and it could be construed that this proposed solution is a quasi-correspondence course with students who are continuing their studies into the summer program. Hence, they are already "enrolled" in the course.

Student Materials

Looking at the lessons more closely, each one consists of two parts (See Appendix A). The first part is a series of computational problems utilizing one of the basic skills and resembles a traditional worksheet. The second part is a puzzle utilizing the basic operations. Cross number puzzles and Spacedust (R) pictures are used for this portion. (Spacedust pictures are published by Spacedust, Inc., Ashtabula, Ohio, and are a part of their Arithmetic Funbooks series.) The purpose of using the two part approach was to maintain the students interest when attempting the lesson. Further, the puzzle page could possibly act as a review which could slow the learning loss.

Overall, the lessons were not designed to present new concepts. Rather, they were designed as a review

instrument. This was done for several reasons. The first was to keep the parents from finding themselves in the embarrassing and/or time consuming situation of playing teacher. The second was that, according to psychologists, review at gradually increasing intervals enables material to be retained for some time. Finally, each time a topic is relearned, the time for mastery is shortened.

Turning to the directions and answer keys, the need for their inclusion was very evident. Without directions, nearly all lessons fail due to the lack of a definitive direction. Answer keys were needed to act as reinforcement, and reinforcement to be most effective in learning must follow closely after the desired behavior and be clearly associated with that behavior in the mind of the learner. Also, behavior which is rewarded is more likely to reoccur. Finally, practice is not enough. Anderson (1967) concluded that a knowledge of results facilitates learning which implies that the learner cannot improve by repeated efforts unless he is informed about how well (or poorly) he has done.

Keeping in mind the psychological principles about learning, forgetting, reward, and reinforcement, the

lessons were developed in May, 1973. The teachers and administrators in the schools involved were asked to critique the overall plan as well as the materials which would be sent home. After the staff approval was gained, the lessons were further critiqued by Mrs. Verena Sharkey, Elementary Mathematics Specialist, Newark School District, and Dr. William B. Moody, Professor of Elementary Mathematics Education, University of Delaware for the purpose of determining their applicability and grade level placement.

Experimental vs. Control Group Assignment

Concurrently, with the development of the student materials, the pupils were assigned to one of three ability levels; high, average, or low. This assignment was much on the basis of their ability test results on the Delaware Educational Assessment Program (DEAP). This testing program is administered each year by the State of Delaware to all first, fourth, and eighth grade students and was designed by Educational Testing Service, Princeton, New Jersey. The students were then pre tested using Form 4A of the Sequential Tests of Educational Progress (STEP) Arithmetic Computation Test, copyright,

1969. On the basis of this test, the students were assigned to the experimental or control group. This assignment was done by first ranking the students within the ability levels on the basis of their test scores and then by using a random number table making the assignments of each pair of students to either the control or experimental group.

Finally, the parents of the students assigned to the experimental group were notified and given the option of not participating. Five parents refused to permit their children to participate. Four indicated they were moving to another area, and the fifth gave no reason. After the parents' permission was obtained, the materials were then distributed to the student on the last day of the 1972-73 school year.

During September, the first week of the 1973-74 school year, the students were given the same STEP Computation Test as a post test. This completed the first phase of the study. At this point then the data was analyzed in order that it could be used as a tool to attack the next part of the problem. Namely, if the results were positive, could the teachers be persuaded

to reduce the amount of time spent on review?

Data Analysis

Recognizing the fact that there would be students who would not complete the lessons, the decision was made to consider three categories of students: those who satisfactorily completed the summer lessons, those who partially completed the summer lessons, and those who did not attempt the summer lessons. The satisfactory completion category consisted of students who completed two or three lessons, while the did not attempt category consisted of the students who completed zero or one lesson.

A 3 X 2 X 2 factorial design based on three ability levels, two grades, and experimental or control (treated as repeated measures) was conducted on the data of the students who satisfactorily completed the summer lessons. The data for the students who did not complete the lessons were analyzed for indications or trends pointing to particular types of students who might not have completed the work, and were further analyzed using a 2 X 2 X 2 factorial design based on two grades, two levels completed (zero or one, two or three), and experimental

vs. control (treated as a repeated measure).

Overall, 322 students were originally included in the study of which 178 were fourth graders and 144 were fifth graders. Table 1, Table 2, Table 3A, and Table 3B which follow give a complete breakdown of the students by number and percent in each category.

TABLE 1

Grade Four Students Categorized by Number of Lessons Completed

Lessons Completed

	(0-1)	(2-3)	(4-5)	Other	Total
Boys	10	6	21	3	40
%	11.2%	6.7%	23.6%	3.4%	44.9%
Girls	13	9	24	3	49
%	14.6%	10.1%	27.0%	3.4%	55.1%
Total	23	15	45	6	89
%	25.8%	16.9%	50.6%	6.7%	100%

TABLE 2

Grade Five Students Categorized by Number of Lessons Completed

	Lessons Completed				
	(0-1)	(2-3)	(4-5)	Other	Total
Boys	4	7	18	8	37
%	5.6%	9.7%	25.0%	11.1%	51.4%
Girls	6	2	21	6	35
%	8.3%	2.8%	29.2%	8.3%	48.6%
Total	10	9	39	14	72
%	13.9%	12.5%	54.2%	19.4%	100%

TABLE 3A

Distribution of Grade Four Students Who Did Not Complete Lessons by Ability Level

	Lessons Completed		Totals
	(0-1)	(2-3)	
High Ability Grade 4	8	5	13
Percent	21%	13%	34%
Aver. Ability Grade 4	8	5	13
Percent	21%	13%	34%
Low Ability Grade 4	7	5	12
Percent	18%	13%	32%
Total Grade 4	23	15	38
Total Percent	61%	39%	100%

TABLE 3B

	Lessons Completed		Totals
	(0-1)	(2-3)	
High Ability Grade 5	1	1	2
Percent	5%	5%	11%
Aver. Ability Grade 5	5	3	8
Percent	26%	16%	42%
Low Ability Grade 5	4	5	9
Percent	21%	26%	47%
Total Grade 5	10	9	19
Total Percent	53%	47%	100%

Of the 57 students who did not complete the lessons, 30 (53%) were girls and 27 (46%) were boys, which implies that sex is not an important factor in whether or not the student completed the lessons. There was also little difference when considering the school or district they attended.

When investigating ability levels, little difference was noted among the fourth graders who failed to complete the lessons, with 13 (34%) falling into the high ability

range, 13 (34%) falling into the average ability range, and 12 (32%) falling into the low ability range. For the fifth graders, however, only 2 (10%) fell into the high ability range, while 8 (42%) and 9 (47%) fell into the average and low ranges respectively.

Although a small sample, the fifth grade pattern seems to indicate ability level might be a predictor of failure to complete the lessons. Indeed, a similar pattern might have possibly been found in the fourth grade, except for the fact that a school boundary shift was made in one of the districts during the summer vacation. Fourteen students indicated they did not complete the lessons for this reason. Nine of these students were in the high ability range, four were in the average ability range, while one was in the low ability range.

Table #4 which follows summarizes the results of the analysis of variance performed on the data obtained from the students who did not complete the lessons, while Table #5 lists the means for the various groups. As stated before, this analysis was based on two grades, two levels of lessons completed, and experimental vs.

control (treated as a repeated measure).

TABLE #4

Analysis of Variance Results for Students Who Did Not Complete the Lessons

Source	SS	df	MS	F
Between Subjects	9275.74	56		
A (grade level)	504.03	1	504.3	3.05
B (lessons completed)	1.78	1	1.78	<1.00
AXB	17.75	1	17.75	<1.00
Error	8752.18	53	165.13	
Within Subjects	2005.00	57		
C (exp.-control)	16.98	1	16.98	<1.00
AXC	15.27	1	15.27	<1.00
BXC	110.73	1	110.73	3.54
AXBXC	205.79	1	205.79	6.58
Error	1656.23	53	31.24	

TABLE #5

Means for Student Groups Who Did Not Complete Lessons

No. of Lessons Completed	Exp.	Control
(0-1)	36.3	37.2
(2-3)	38.6	35.5

It is interesting to note that grade level is not significant, but this is to be expected due to the distribution by ability, with many more 4th graders in the

high ability range than 5th graders. While not significant at the .05 level, the interaction of lessons completed and experimental-control indicates a tendency toward a higher mean for the students who completed more lessons. This trend might lead one to suspect that completing lessons did help to maintain the basic skills.

Turning to the analysis of the data for the students who completed the lessons, the design was a 3X2X2 factorial design with 3 ability levels, 2 grades, and experimental-control groups (treated as repeated measures). Table #6 summarizes the analysis of variance performed, while Table #7 lists the means for the various groups.

TABLE #6

Analysis of Variance Results for Students Who Completed the Lessons Satisfactorily

Source	SS	df	MS	F
Between Subjects	19175.50	83		
A (grade)	1975.85	1	1975.85	49.34*
B (ability)	13916.01	2	6958.00	173.64*
AXB	158.01	2	79.00	1.97
Error	3125.63	78	40.07	

Table #6 continued

Source	SS	df	MS	F
Within Subjects	2741.50	84		
C (exp.-control)	1388.77	1	1388.77	87.23*
AXC	14.44	1	14.44	<1.00
BXC	92.75	2	46.37	2.72
AXBXC	3.22	2	1.61	<1.00
Error	1242.25	78	15.92	

* $p < .001$

TABLE #7

Group Means for Students Who Completed the Lessons by Grade

		Exp.(Post)	Control (Post)
	Hi	50.5	46.7
Grade 4	Aver.	39.5	34.5
	Low	28.1	21.3
Total Grade 4		39.4	34.2
	Hi	54.8	50.7
Grade 5	Aver.	49.0	42.4
	Low	36.7	28.3
Total Grade 5		46.8	40.5
Total Gr. 4 & 5		42.8	37.1

As is to be expected, the differences between grades and between ability levels are highly significant. Of interest however, is the significant difference between the experimental and control groups. At each of the ability levels, the students in the experimental group maintained their scores, while the students in the control group dropped an average of 4 to 8 points. Overall, the mean difference was better than 5 points in favor of the experimental group. The conclusion obviously, seems to be that the summer lessons did help to maintain the basic skills.

THE PROPOSED SOLUTION - PART II

Even though the results of the data analysis were highly significant in favor of the experimental group, the project would be little more than an academic endeavor (and indeed could be considered a waste of time) if the teachers involved do not accept the results and modify their behavior accordingly. Therefore, an attempt was made to use the results of this study as the basis for persuading teachers to change their outlook toward the need for review in the fall of the year.

With the preceeding in mind, the results of the data analysis were shared with the teachers and administrators of the students involved in the study. The number of teachers initially involved consisted of six fourth grade teachers and five fifth grade teachers. In addition, the students in fifth grade in May entered three different middle schools and were assigned to seven different middle school teachers. Thus, students of 18 teachers were involved in the study.

Each of the 18 teachers received the results of the study shortly before a meeting was held with them in order that they could have time to look over the results.

The purpose for holding the meeting was three fold. The first was to determine the amount of time the teachers expected to spend on review. This was gathered, and the results are summarized in Table #8.

TABLE #8

Teacher Estimate of Review Time Needed by Their Students
(Second Week of School)

Number of Weeks	7-8	9-10	11-12
Grade 4 Teachers	1	3	2
Grade 5 Teachers	2	2	1
Grade 6 Teachers	3	3	1

As can be seen by inspecting Table #8, the average amount of time to be spent on review is about 9 weeks, or about 25% of the school year, while four teachers were planning to spend nearly 33% of the school year reviewing basic skills!

The second purpose of the meeting was to clarify any questions the teachers might have had concerning the results of the summer study, while the third was to use the data results as the basis of an appeal to the teachers to reduce the review time.

The teachers were not discouraged from using periodic review, in fact, this use of review was highly encouraged.

After a period of six weeks (eight weeks after the start of the 1973-74 school year) a follow-up survey was conducted, and personal observations in each classroom were made. Through the survey and the observations it was determined that two teachers reduced their review time to three weeks, three had reduced their review time to four weeks, while only one indicated a need for still utilizing twelve weeks. Table #9 summarizes the results of the followup visitations and surveys.

TABLE #9

Teacher Use of Review Time for Their Students
(Eighth Week of September)

Number of Weeks	3	4	5	6	7	8	9-10	11-12
Grade 4 Teachers	-	1	2	-	1	-	1	1
Grade 5 Teachers	1	1	1	1	-	-	1	-
Grade 6 Teachers	1	2	1	2	-	-	1	-

It can readily be seen that the average time spent on review time was about six weeks. This was a decrease of 33% from the original estimate of nine weeks. Obviously, this represents a considerable number of student days which can be used for other pursuits.

CONCLUSION

In light of the fact that the basic skills were maintained during the summer vacation, and the teachers subsequently reduced the amount of time spent on review, this method seems to have considerable merit and attempts will be made to expand its use in the Newark District.

However, if one were considering the adoption of such a scheme, it must be remembered that there was no attempt to teach new material and only basic skills

were presented. Further, it is imperative to involve the teachers and administrators at each step of the process, for this investigator feels that this contributed to the success of the project as much as the convincing statistical results.

Name_____ School_____

LESSON #1A

ADDITION AND SUBTRACTION

Example:

```
  11
  4325
  6078
+ 5294
 15697
```

A. Add the ones
   5 + 8 + 4 = 17 ones
B. Rename 17 as 1 ten and 7 ones
C. Add the tens
   1 + 2 + 7 + 9 = 19 tens
D. Rename as 1 hundred and 9 tens
E. Follow a similar pattern for the hundreds and thousands

---

1. 342 + 325

2. 725 + 146

3. 425 + 1723

4. 3156 + 1327

5. 43 + 17 + 13

6. 435 + 16 + 127

7. 4113 + 1590 + 2671

8. 234 + 357 + 214 + 526

Example:

```
  11
 X15
 1253
 -582
  671
```

A. Subtract the ones. 3 - 2 = 1
B. To subtract tens, rename 1000 + 200 + 50 as 1000 + 100 + 150. Subtract tens. 150 - 80 = 70
C. To subtract hundreds rename 1000 + 100 as 1100. Subtract hundreds. 1100 - 500 = 600.

---

9. 625 - 401

10. 634 - 307

11. 908 - 436

12. 1765 - 934

13. 2576 - 882

14. 5724 - 1543

15. 6753 - 1908

16. 17024 - 9653

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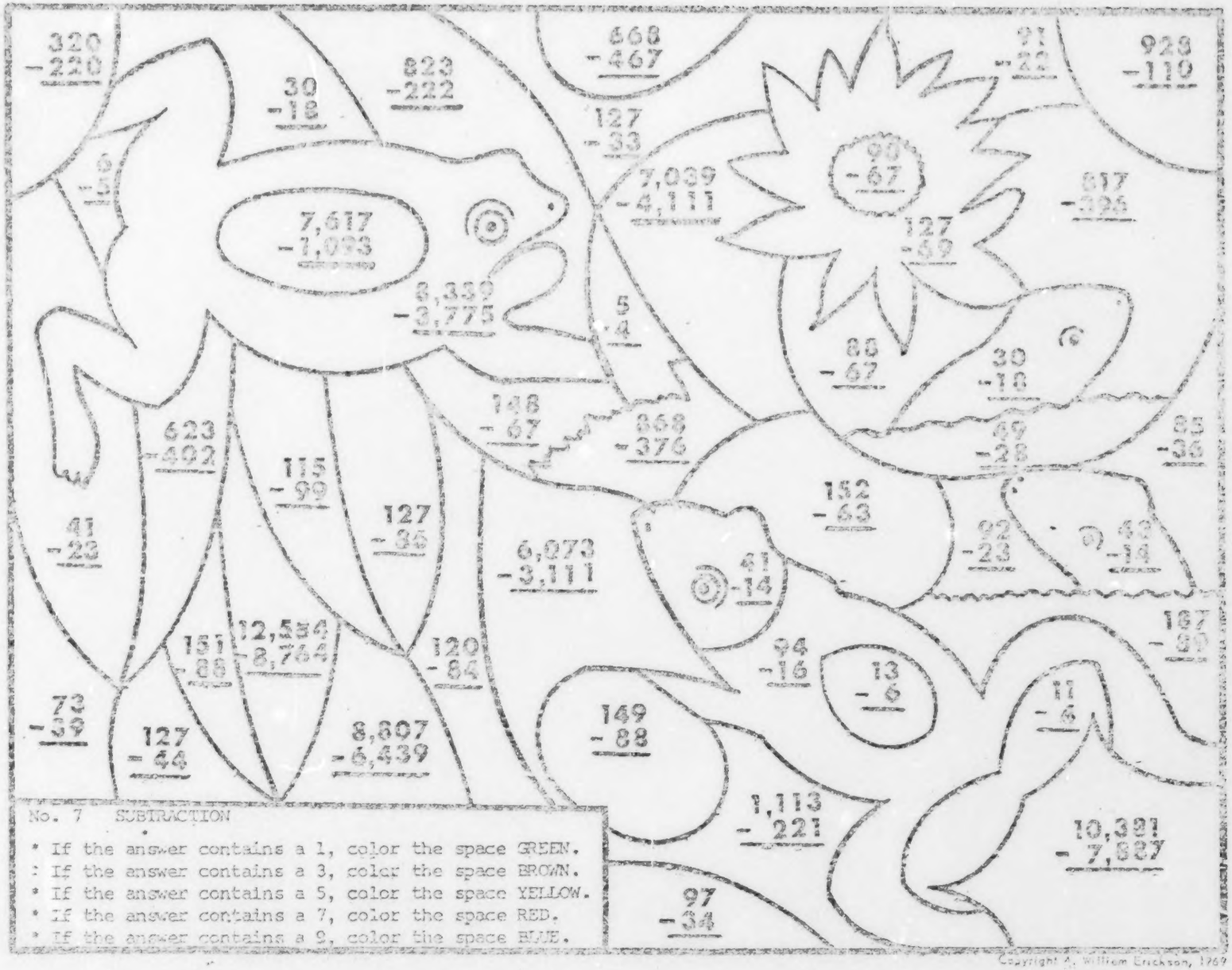

No. 7 SUBTRACTION

* If the answer contains a 1, color the space GREEN.
* If the answer contains a 3, color the space BROWN.
* If the answer contains a 5, color the space YELLOW.
* If the answer contains a 7, color the space RED.
* If the answer contains a 9, color the space BLUE.

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